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Meat Quality of Broiler Chickens Fed Diets Containing some Tropical Leaves as Replacement of 50% Dietary Methionine

Fawolu, T. S.; Onibi, G.E.; Igbasan, F.A.; Agoola, O.T.

Department of Animal Production and Health, Federal University of Technology, Akure, Nigeria

Abstract— *Meat quality, carcass and organ characteristic of arbo acre breed of broiler chicken fed diets containing moringa, fluted pumpkin and African spinach meals and their composites as replacement for 50% synthetic methionine in diets were examined using a completely randomized experimental design involving two hundred and forty (240) chicks. Which were randomly distributed into eight dietary treatments of three replicates per treatment and ten birds per replicate. This study lasted for six weeks. At the end of the experiment, three (3) birds per replicate were randomly selected and slaughtered. The carcass and the organs characteristic were measured and thigh, breast and drumstick were separated for meat quality analysis. The carcass characteristic were all significantly ($P \geq 0.05$) differ with moringa having the highest. The organ characteristic shows that there were no significant ($p \leq 0.05$) difference in all the parameters except for the belly fat. The meat quality ($P \leq 0.05$) affected. There was improvement in thaw loss, tenderness, juiciness and overall acceptability of the meats with the inclusion of the leaf mills. The composite leaf meal inclusion gave the overall best result. It was concluded that the selected leaf meals and their composite could be used to replacement 50% synthetic methionine in poultry diet.*

Keywords— ***broiler chickens, tropical leaves, meat qualities.***

I. INTRODUCTION

The increase in demand for poultry meat has given rise to the use of synthetic compounds in feed and the high price of such compounds like synthetic methionine has brought about increase in the cost of poultry feeds. The safety of such practice has been questioned and their use is becoming restricted in many regions of the world. Therefore, there has been great interest in developing natural alternative supplements to maintain animal performance and wellbeing (1). Broilers have a high methionine requirement that cannot be obtained from corn/maize and soyabean fraction of diets; therefore, broilers require an additional source of methionine. The use of synthetic methionine in organic feed has been criticized for increasing bird growth rather than health as well as for chemical processing associated with production of the additive (2).

Vegetable-based feeds are rich source of essential plant amino acids, vitamins and minerals. Furthermore, it has been established that green vegetable leaves are the cheapest and most abundant source of proteins because of their ability to synthesize amino acids from a wide range of available primary materials such as water, carbon dioxide and atmospheric nitrogen (3).

Leaves from some tropical plants such as Moringa (*Moringaoleifera)*, Fluted pumpkin *(Telfairaoccidentalis)* and African spinach *(Amaranthuscruentus L)* contain appreciable methionine. These tropical leaves when used in feed may have effect on the performance and product quality of chickens. Thus, this study is to assess the meat quality of the broiler chickens fed diets containing some tropical leaf meals in replacement of synthetic methionine.

II. MATERIALS AND METHODS

The experiment was carried out at the Poultry Unit of the Teaching and Research (T&R) Farm of The Federal University of Technology Akure (FUTA), Ondo State of Nigeria. *Amaranthuscruentus*, *Telferiaoccidentalis* and *Moringaoleifera* leaves were harvested from Abivict Farms Nigeria, Ilara-Mokin, Ondo State, Nigeria. The leaves were air-dried in a well-ventilated environment for a period of 4-7 days. The dried leaves were milled with a

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hammer mill at the (T&R) Farm Feed Mill of the FUTA. After milling, the composites were produced and the leave meals and their composites were stored in a tightly sealed polythene material to prevent it from absorbing moisture from the environment. A total of 300 day-old Arbor Acre broiler chicks were procured from Farm Support Services Limited, Ibadan, Nigeria and 240 of the chicks of average weight were selected. Ten chicks were randomly selected, weighed and allotted to eight dietary treatments in a Completely Randomized Design (CRD) and were reared on deep litter house which was partitioned into pens as experimental units, water and feed were offered *ad libitum* throughout the study period. All the necessary routine management practices and the recommended vaccinations were strictly observed throughout the feeding trial period of 42 days (starter; 3 weeks and finisher; 3 weeks). The basal composition of the starter and finisher diets are presented in tables 1 and 2 respectively.

At the end of the experimental period, three birds were randomly selected from each replicate for slaughtering. The birds were weighed, mechanically stunned by hitting knife's base on the chickens head, slaughtered by cutting of the jugular vein, bled, de-feathered and eviscerated. All the part both external and internal were separated and weighed for carcass and organ characteristic respectively. Three muscle types (chest, thigh and drumstick) were collected from each sample in different packs and preserved in refrigerator and freezer as appropriate.

2.1 Meat quality evaluation

Cooking loss determination, palatability test, moisture content of the meat samples, thaw loss, fat determination and oxidative stability of meat were done by method described by (2).Proximate analysis of the leaf samples; the percentage of moisture, ash, ether extract, crude fibre, and crude protein content of the leaves were carried out by the methods of (4).

Statistical Analysis; all data generated were analyzed by one-way analysis of variance (ANOVA) using the Statistical Package for Social Sciences (SPSS version 20). The significant differences between means were separated using the Duncan's Multiple Range test (DMRT) of the same Statistical Package.

III. RESULT

Carcass characteristic of broiler chickens fed the experimental diets are presented in the table 2. There were significantly ($p \leq 0.05$) different in all the carcass parameters except in the back weight, the dress weight percentage was highest in diet3 with value (87.94%) and the least value (82.62%) was recorded for diet4. The values of eviscerated weight ranged between diet5 having 73.37% and diet2 having 77.20%. The back weight varies between 129.81g in diet8 and 134.64g in diets1. The drumstick weight was highest in diet1 with value 119.28g and the least value 87.48g in diet2 but there were no significant ($p \geq 0.05$) different in the values for diet3, diet4, diet5, diet6 and diet7. The thigh muscle weight ranged between diet5 and diet1 with values 78.52g and 115.70g respectively and there were no significant ($p \geq 0.05$) different between diet3 and diet4 and also among diet2, diet5, diet6, diet7 and diet8. Chest muscles had the least value (183.30g) in diet2 and highest value (209.06g) in diet1. The weight of head ranged between diet8 and diet1 with values 19.68g and 26.20g respectively. The values recorded for shank ranged between diet7 and diet8 with values 30.66g and 42.45g respectively. The values recorded for wing ranged between diet1 and diet6 with values 70.87g and 80.67g respectively, there were no significant ($p \geq 0.05$) different in diet1 and diet7 and also among diet2 and diet4

The organ characteristic of broiler chickens fed diets containing replacement of 50% synthetic methionine with tropical leaves are presented in the table 3. There were no significantly ($p \geq 0.05$) different in all the organ parameters except in the belly fat. The liver had the highest value (18.50g/kg body weight) in diet1 and the least value (17.08g/kg body weight) was recorded for diet8. The values of kidney weight ranged between diet3 having (3.20g/kg body weight) and diet7 having (3.90g/kg body weight). The heart weight varies between (3.34g/kg body weight) in diet8 and (3.96g/kg body weight) in diets3. The lung weight was highest in diet1 with value (5.30g/kg body weight) and the least value (4.20g/kg body weight) in diet6. The pancreas weight ranged between diet2 and diet3 with values (2.40g/kg body weight) and (3.000g/kg body weight) respectively. Spleen had the least value ((0.90g/kg body weight)) in diet8 and highest value (1.15g/kg body weight) in diet4. The recorded values of gizzard ranged between diet2 and diet1 with values (19.00g/kg body weight) and (20.70g/kg body weight) respectively. The weight of belly fat were significantly ($p \leq 0.05$) different and ranged between diet8 and diet1 with values (3.20g/kg body weight) and (6.90g/kg body weight) respectively, there were no significant ($p \geq 0.05$) different among diet2, diet3 and diet4, diet5 and diet7 have the same level of significancy and diet6 and diet8 also are not significantly different. The values recorded for proventricullus ranged

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between diet7 and diet1 with values (3.40g/kg body weight) and (5.50g/kg body weight) respectively, for diet6, diet7 and diet8 the same value were recorded. Table 3; shows the result for the moisture and fat contents of broiler chickens fed diets containing some tropical green leaves in replacement of methionine. The moisture content for the three muscle types (thigh, breast and drumstick) were significantly (P<0.05) influenced by dietary treatments. Values obtained for moisture content did not follow any specific trend. The values of the thigh muscle ranged between 65.61 and 76.98%; for breast, the values ranged between 72.31 and 75.04% and for drumstick; 76.38 and 78.33%. The drumstick had the highest moisture content with 78.33% while the thigh muscle had the lowest with 65.61%. Broiler chickens fed diet 3 (76.98%) had the highest moisture content for thigh, while those fed diet 8 (65.61%) had the lowest. Broiler chickens fed diet 2 (75.04%) had the highest in breast, while those fed diet 4 (72.31%) had the lowest. In the drumstick, broiler chickens fed diet 7 (78.33%) had the highest while those fed diet 6 (76.38%) had the lowest. Broiler chickens fed diet 1 and diet 6 were not different significantly (P>0.05) in the thigh, those fed diet 1, diet 2, diet 3 and diet 8 were also not significant in the breast muscle type, while those fed diet 1, 2, 3, 5 and 7 meat samples were not significantly (P<0.05) different in the drumstick.

The fat content for the muscle types were significantly (P<0.05) influenced by the dietary treatments. It ranged between 5.83 and 7.87% in the thigh, between 5.57 and 6.83% in the breast and between 5.69 and 6.98% in the drumstick. The thigh had the highest lipid with 7.87% while the breast had the lowest. Broiler chickens fed diet 3 had the highest both in the thigh and drumstick, those fed diet 7 had the highest in the breast muscle while those fed diet 1 (control) had the lowest in all the muscle types. Broiler chickens fed diet 1 were totally different from all other diets in all the muscle types (thigh, breast and drumstick).

The cooking losses of the meat were significantly (P<0.05) influenced by dietary treatments. The cooking loss of the thigh ranged between 20.94 and 30.80%. The breast muscle values ranged between 20 and 28.88% and for drumstick, between 16.46 and 26.71%. In the thigh muscle, broiler chickens fed diet 5 had the highest cooking loss (30.80%) while those fed diet 4 had the lowest (20.94%). In breast muscle type, broiler chickens fed diet 8 had the highest (28.88%) while those fed diet 3 had the lowest cooking loss (20.00%). In the drumstick, broiler chickens fed diet 6 (26.71%) while those fed diet 4 (16.46) had the lowest. Broiler chickens fed diet 1, 3,5, 6 7 and 8 were not significantly (P>0.05) different from each other in the thigh muscle, those fed diet 1 and diet 7 were not also significantly (P>0.05) different in the breast muscle. The thigh muscle had the highest with 30.80% while the drumstick had the lowest with 16.46%.

The thaw loss for the muscle types were significantly (P<0.05) influenced by dietary treatments. The value for thigh muscle ranged between 0.51 and 9.24%. The value for the breast muscle ranged between 2.05 and 4.56% while that of drumstick ranged between 0.65 and 1.82%. Broiler chickens fed diet 1 (control) had the highest thaw loss (9.24%) in the thigh while those fed diet 8 had the lowest (0.51%). Broiler chickens fed diet 4 had the highest (4.56%) value in the breast muscle while those fed diet 1 had the lowest (2.05%). In the drumstick, broiler chickens fed diet 1, 6, 7 and 8 were not different from each other. In the drumstick, the chickens fed diet 4 had the lowest (0.65%) while those fed diet 1 had the highest (1.82%).

The tenderness, juiciness and flavour of the meat samples were significantly (P<0.05) different from each other, but the overall acceptability were not significantly (P>0.05) influenced by the dietary treatments. The tenderness of the samples ranged between 6.00 and 7.50, the juiciness ranged between 5.70 and 7.70, the flavour ranged between 5.50 and 8.00 while the overall acceptability ranged between 6.40 and 7.60. Broiler chickens fed diet 7 had the highest overall acceptability followed by those fed diet 4 while those fed diet 1had the least.

The oxidative stability of the meat samples were significantly (P<0.05) influenced by the dietary treatments. It ranged between 0.17 and 0.29mgMDA/kg meat in day-one sample and between 0.21 and 0.64mgMDA/kg meat in the day-five sample. The highest oxidation occurred in broiler chickens fed diet 3 day-five sample, followed by those fed diet 2, but the lowest oxidation occurred in the meat of broiler chickens fed diet 6.

4 Discussions

The result of the organs and carcass characteristic was within the range recorded by (6), (1), and (2).The moisture content of meat is related to its water holding capacity. The result of this study shows that the moisture content were significantly (P<0.05) influenced by the treatments. The value of the moisture contents did not follow any particular trend. However, the moisture contents of the meat fell within the range of 65 and 78% reported by (7), (8), and (9), and also close to the range 74.7 and 75.03% reported

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for meats from broiler chickens on plant supplemented feed by (10). Despite the significance of the moisture content, the meat quality of broiler chickens fed diets containing the selected leave meals were not adversely affected. The breast had the highest numerical moisture content of 78.64%.

The lipid of the meat samples were significantly (P<0.05) different from each other. The fat content of the broiler chickens fed diets containing the selected leave meals were higher as compared to the control. The fat content of the muscles fell between 4 and 12% just as it was reported for poultry by (8) and (9). Therefore, the dietary treatments did not have adverse effect on the quality of the meat. Thigh muscle had highest numerical fat content (7.87%).

Cooking loss of meat refers to the weight of the fluid exudates drained from meat after cooking (11). Low water holding capacity and low pH result in high cooking loss. The cooking losses of the meat were significantly (P<0.05) influenced by dietary treatments. The cooking loss values did not follow any particular trend. According to (12), meat with cooking loss of 20-25% has an excellent flavour while cooking loss of 40-50% makes meat too dry. However, the cooking losses from meat samples recorded in this study were below 40%. The thigh has the highest cooking loss (30.80%).

The thaw loss of meat refers to the melting process of conversion from frozen state to a liquid state (13). The result of this study showed that the thaw loss of the muscle type were significantly influenced by the dietary treatments. According to (13), meats with high percentage thaw loss are hard and tasteless, but from this study, the control diet had the highest thaw losses in both the thigh and drumstick muscle types. This implies that the dietary treatment did not have adverse effect on the meat quality in terms of thaw loss because the percentage thaw loss was minimum and nutritional quality could be lost due to leaching of soluble protein and flavour, high energy consumption and large quality of loaded waste water through high percentage of thaw loss.

Lipid oxidation is the primary process responsible for quality deterioration of meat during storage (14). The oxidative stability of the thigh were significantly (P<0.05) influenced by dietary treatments. The result of the extent of oxidation of the meat during refrigerated storage shows that the rate of oxidation in the muscle did not follow any particular trend. Broiler chickens fed diet 3 had the highest oxidation at day-five (0.64mgMDA/kg meat) and this could be justified with the high fat content of the thigh (7.87). The lowest oxidation at day-five was recorded in diet 6 (0.21mgMDA/kg meat), which could be attributed to the low fat content (5.89%) of the thigh.

The critical point of appraisal of meat quality arises when the consumer eats the product, its outcome in terms of level of satisfaction derived determines the decision to repurchase (15). The overall acceptability of the meat was not significantly (P>0.05) influenced by the dietary treatments, but the flavour, tenderness and juiciness were significantly (P<0.05) influenced by the dietary treatments. The thigh meat from broiler chickens fed diet 7 appeared best in terms of the overall acceptability, flavour and juiciness, other diets containing the selected leaf meal also had high overall acceptability, flavour and juiciness as compared to the control. This implies that inclusion of tropical leaf meals in the diet of broiler chicken enhanced the taste and acceptance of its meat. This may be due to high fat content of the broiler chickens' meat fed tropical leaves in replacement of methionine since fat content of meat is one of the factors that influences its taste and palatability according to (8).

IV. CONCLUSION

The meat quality of broiler chickens fed diets containing some tropical leaf meals from *Moringaoleifera*, *Telfairiaoccidentalis* and*Amaranthuscruentus* in replacement of synthetic methionine were not adversely affected. There were beneficial influence of the leaf meal replacement for synthetic methionine in terms of reduced thaw loss and improved tenderness, juiciness and overall acceptability of the meat. The leaf meals combination in diet 6 (25% *Amaranthuscruentus*, 50% *Moringaoleifera* and 25% *Telfairiaoccidentalis*) and diet 7 (25% *Amaranthuscruentus*, 25% *Moringaoleifera* and 50% *Telfairiaoccidentalis*) gave the best result in improving meat quality.

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Table 1: Composition of the Broiler-Finisher Diets for the Feeding Trial (%)

Ingridient	Diet 1	Diet 2	Diet 3	Diet 4	Diet 5	Diet 6	Diet 7	Diet 8
Maize	60.00	60.00	60.00	60.00	60.00	60.00	60.00	60.00
Groundnut Cake	3.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
Fish Meal	8.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00
Soybean Cake	25.00	25.00	25.00	25.00	25.00	25.00	25.00	25.00
Bone Meal	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20
Oyster Shell	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
Lysine	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10
Methionine	0.10	0.05	0.05	0.05	0.05	0.05	0.05	0.05
Salt	0.30	0.35	0.35	0.35	0.35	0.35	0.35	0.35
Vit/Min Premix	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30
AM	0.00	3.00	0.00	0.00	0.00	0.00	0.00	0.00
MM	0.00	0.00	3.00	0.00	0.00	0.00	0.00	0.00
MU	0.00	0.00	0.00	3.00	0.00	0.00	0.00	0.00
C1M	0.00	0.00	0.00	0.00	3.00	0.00	0.00	0.00
C2M	0.00	0.00	0.00	0.00	0.00	3.00	0.00	0.00
C3M	0.00	0.00	0.00	0.00	0.00	0.00	3.00	0.00
C4M	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.00
Total	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**
Calculated analysis								
Crude protein (g/kg)	20.11	20.06	20.06	20.36	20.16	20.19	20.24	20.19
Metabolizable Energy (Mj/kg)	3005	2972	2971	2982	2950	2980	2980	2979
Calcium	1.23	1.23	1.23	1.23	1.23	1.23	1.24	1.23
Phosphorus	0.53	0.54	0.54	0.54	0.54	0.52	0.54	0.54
Methionine	0.40	0.35	0.45	0.45	0.45	0.45	0.45	0.45
Lysine	1.10	1.15	1.20	1.17	1.17	1.18	1.17	1.17
Ether Extract	4.10	4.15	4.23	4.14	4.17	4.19	4.16	4.17
Crude Fiber	3.44	3.53	3.51	3.70	3.57	3.56	3.61	3.58
Proximate Analysis								
Moisture Content	8.58	8.52	8.78	8.45	7.94	8.37	8.36	8.53
Ash	5.98	5.54	5.03	4.98	5.81	5.32	6.2	5.72
Crude Fiber	3.65	3.41	3.48	3.65	3.47	3.52	3.514	3.21
crude Protein	23.14	23.03	23.12	23.23	23.21	23.13	23.31	23.45
Ether Extract	2.41	1.94	2.53	2.38	1.81	2.43	2.41	2.12
Nitrogen Free Extract	55.7	51.99	52.19	54.09	53.07	54.37	53.66	52.17

Diet 1 (control) contained no leaf meal, Diet 2 contained 100% *Amaranthuscruentus*leaf meal, Diet 3, 100% *Moringaoleifera*leaf meal, Diet 4,100% *Telferiaoccidentalis*leaf meal, Diet 5, 50% *Amaranthuscruentus*, 25% *Moringaoleifera*and 25% *Telferiaoccidentalis*leaf meal, Diet 6,25% *Amaranthuscruentus*, 50% *Moringaoleifera*and 25% *Telferiaoccidentalis*leaf meal, Diet 7, 5% *Amaranthuscruentus*, 25% *Moringaoleifera*and 50% *Telferiaoccidentalis*leaf meal and Diet 8 contained 33.3% *Amaranthuscruentus*, 33.3% *Moringaoleifera*and 33.3% *Telferiaoccidentalis*leaf meal.

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Table 2 Carcass Characteristics of Broiler Chicken Fed with Tropical Leaf Meals and Their Composites Based Diets

	DIETS
	Dietary inclusion of composite leaf meals to replace 50% inclusion of methionine
Final Weight (g)	
Dress Weight (%)	
Evicerated Weight (%)	
Back (g/kg body weight)	
Drumstick (g/kg body weight)	
Thigh (g/kg body weight)	
Chest (g/kg body weight)	
Neck (g/kg body weight)	
Head (g/kg body weight)	
Shank (g/kg body weight)	

Table 3: Organ Characteristics of Broiler Chicken Fed with Tropical Leaf Meals and Their Composites Based Diets

	DIETS
	ion of composite leaf meals to replace 50% inclusion of methionine
Final Weight (kg)	
Liver (g/kg body weight)	
Kidney (g/kg body weight)	
Heart (g/kg body weight)	
Lung (g/kg body weight)	
Pancreas (g/kg body weight)	
Spleen (g/kg body weight)	
Gizzard (g/kg body weight)	
Belly Fat(g/kg body weight)	
Proventricullus (g/kg body weight)	

Table 4:Moisture and Fat Contents of Broiler Chickens Fed Diets Containing Some Tropical Leaves in Replacement of 50%Methionine

	DIETS
	ion of composite leaf meals to replace 50% inclusion of methionine
Moistuer Content	
%	

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Fat (%)

Table 5: Cooking and Thaw Losses of Broiler Chickens Fed Diets Containing Some Tropical Leaves in Replacement of 50% Methionine.

Parameters	Muscle	DIETS — Dietary inclusion of composite leaf meals to replace 50% inclusion of methionine								
		Diet1	**Diet2**	**Diet3**	**Diet4**	**Diet5**	**Diet6**	**Diet7**	**Diet8**	**SEM**
Cooking Loss (%)	Thigh	28.96cd	24.86b	28.65cd	20.94a	30.80d	30.76d	28.01cd	25.96bc	0.71
	Breast	24.95d	26.03e	20.00a	23.74c	23.90c	21.99b	24.88d	28.88f	0.52
	Drumstick	25.79e	24.54d	21.63b	16.46a	23.44c	26.71f	21.09b	21.32b	0.64
Thaw Loss (%)	Thigh	9.24e	1.35d	0.95c	1.01c	1.02c	0.80b	1.03c	0.51a	0.57
	Breast	2.05a	2.52b	3.12d	4.56e	2.77c	2.42b	2.90cd	2.94cd	0.15
	Drumstick	1.82d	1.41bcd	1.21abc	0.65a	0.96ab	1.28bcd	1.68cd	1.60cd	0.09

Table 4.21:Palatability and Oxidative Stability of Meat of Broiler Chickens Fed Diets Containing Some Tropical Leaves in Replacement of 50% Methionine

Parameters		DIETS — Dietary inclusion of composite leaf meals to replace 50% inclusion of methionine								
		Diet1	**Diet2**	**Diet3**	**Diet4**	**Diet5**	**Diet6**	**Diet7**	**Diet8**	**SEM**
Palatability										
	Tenderness	6.10b	6.40ab	6.00ab	7.70a	7.10ab	6.50ab	7.50ab	7.00ab	0.17
	Juiciness	5.70b	6.40ab	6.20ab	6.40ab	6.90ab	6.90ab	7.70a	6.70ab	0.18
	Flavour	5.70b	7.00ab	5.80b	7.10ab	5.50b	6.40ab	8.00a	7.10ab	0.21
	Overall acceptability	6.40	7.10	6.60	7.60	6.70	6.60	7.60	6.50	0.17
LO (MDA/kg)										
	Day-one	0.24e	0.21c	0.29f	0.21c	0.23d	0.19b	0.17a	0.22cd	0.01
	Day-five	0.27c	0.50f	0.64g	0.31d	0.36e	0.21a	0.24b	0.36e	0.03